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STS-30 National Space Transportation System Mission Report

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NATIONAL SPACE TRANSPORTATION SYSTEM

MISSION REPORT

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INTRODUCTION

The STS-30 National Space Transportation System (NSTS) Program Mission Report contains a summary of the vehicle subsystems activities on this twenty-ninth flight of the Space Shuttle and this fourth flight of the OV-104 (Orbiter) vehicle, Atlantis.

The primary objective of the STS-30 mission was to successfully deploy the Magellan spacecraft. Secondary objectives were to perform all operations necessary to support the requirements of the Fluids Experiment Apparatus (FEA) and Mesoscale Lightning Experiment (MLE), both being middeck experiments and the Air Force Maui Optical Site (AMOS) calibration test, along with the development test objectives (DTO's) and detailed supplementary objectives (DSO's).

The crew for this mission was David M. Walker, Capt., U. S. Navy, Commander; Ronald J. Grabe, Col., U. S. Air Force, Pilot; Mark C. Lee, Major, U. S. Air Force, Mission Specialist 1; Norman E. Thagard, M.D., Mission Specialist 2, and Mary L. Cleave, Ph.D, Mission Specialist 3.

The sequence of events for this mission is shown in Table I. This report also summarizes the significant problems that occurred during the mission. The problem tracking list is presented in Table II to provide a complete list of all Orbiter problems. Each of these problems is cited in the body of the report.

MISSION SUMMARY

An attempt was made to launch the STS-30 mission on April 28, 1989. The launch countdown was held at T-9 minutes because of a loss of redundancy in the range safety computers. The range safety computer redundancy was re-established and the countdown was re-initiated following an additional 5-minute hold at the end of the T-9 minute hold. At T-31 seconds, the launch countdown was automatically held and subsequently scrubbed because of a violation of the Launch Commit Criteria (LCC) engine-start box that resulted from the unplanned shutdown of the liquid hydrogen recirculation pump on Space Shuttle main engine 1. Subsequent inspections and analysis revealed that phase B voltage to the pump was shorted to ground in a connector within the pump, and the pump was replaced and verified operational. A vapor cloud was noted at the External Tank (ET)/Orbiter liquid hydrogen line during the detanking operations, and this resulted in replacing the line prior to the next launch attempt. Additionally, during the countdown, it was noted that the butcher paper covering reaction control subsystem (RCS) thruster L4U was discolored possibly because of a small oxidizer leak. The butcher paper was replaced during the launch scrub activities and the thruster was flown in that condition. Other Orbiter problems noted during the launch attempt are discussed in the following three paragraphs.

After crew ingress and cabin pressurization, the cabin pressure sensor was noted to be reading incorrectly. An inspection after the countdown was scrubbed

revealed that a cap was over the sensor. The cap was removed and tests verified the sensor to be operational.

Between the start-up of the auxiliary power units (APU's) at T-5 minutes and the scrub of the launch following the T-31 second hold, three exhaust gas temperature (EGT) sensors in the APU system appeared to have failed, one on each APU. Loss of these sensors did not result in a launch commit criteria (LCC) violation, therefore, the APU's were flown with the sensors in the failed condition.

Discussions with the crew after the launch scrub revealed that the shoulder harness for Mission Specialist 1 could not be tightened because one of the shoulder strap adjustment retainer clips came loose from the harness. The harness and seat were removed and replaced.

The STS-30 mission was successfully launched at 124:18:46:59.011 Greenwich mean time (G.m.t.) (01:46:59.011 p.m. c.d.t.) on May 4, 1989. The launch countdown was initially held at T-9 minutes (launch minus 16 minutes) for 43 minutes because of unacceptable cloud coverage and crosswind conditions at the Shuttle Landing Facility (SLF), the return-to-launch-site (RTLS) runway. The time-to-launch was changed from L-16 minutes to L-20 minutes when the countdown was resumed at T-9 minutes at 1:15 p.m. c.d.t. The countdown continued for 15 minutes to T-5 minutes when a hold was again initiated awaiting acceptable cloud coverage and crosswinds at the SLF. At 1:41:59 p.m. c.d.t., all conditions were declared acceptable for launch and the final countdown was resumed and successfully completed.

During prelaunch operations at 124:12:30 G.m.t., the water spray boiler (WSB) 2 steam vent temperature dropped below 130 °F and the ready indication was lost. A waiver was prepared should the temperature go below the 123 °F LCC limit; however, the temperature did not decrease to the LCC limit. In addition, the main propulsion system engine 3 gaseous hydrogen pressure system temperature sensor failed off-scale high. This anomaly did not affect the launch phase.

The launch phase was satisfactory in all respects. The final countdown was normal with the Space Shuttle main engine (SSME) and solid rocket motor (SRM) ignitions occurring as expected. First stage ascent performance was nominal with Solid Rocket Booster (SRB) separation, entry, deceleration and water impact occurring as planned. Performance of the SSME's, External Tank (ET), and main propulsion system (MPS) was also as predicted with main engine cutoff occurring at 124:18:55:28.68 G.m.t. One Orbiter subsystem anomaly was noted immediately after external tank (ET) separation. The RCS R1U thruster failed off at 124:18:55:59.99 G.m.t., when initially commanded to fire. The loss of this thruster did not impact the mission as two same-direction-firing pitch thrusters were still available in the right pod of the aft RCS.

The two-engine orbital maneuvering subsystem (OMS) -1 and OMS-2 burns were performed satisfactorily with nominal results. Data analysis has revealed that the right OMS fuel quantity gauging indication did not accurately follow the fuel at the rate it was being used, and the gauging reached a value of 50 percent during the OMS-2 maneuver and remained at that level throughout the OMS-3 maneuver. The gauge indicated a usage rate in excess of the actual rate

during the deorbit maneuver, but the gauge read about 21 percent at the end of the maneuver. This failure did not impact the use of the OMS for the remainder of the mission.

The Magellan spacecraft was satisfactorily deployed at 125:01:01:32 G.m.t., [06:14:33 mission elapsed time (m.e.t.)], followed by the satisfactory deployment of the spacecraft solar panels. The Inertial Upper Stage (IUS) solid rocket motor (SRM) -1 burn was performed as planned at 125:02:01:32 G.m.t. (7:14:33 m.e.t.). The SRM-1 was satisfactorily separated and SRM-2 ignition occurred at 125:02:06:42 (7:19:43 m.e.t.). Data have confirmed that the Magellan spacecraft successfully separated from the SRM-2 and that the Magellan spacecraft is on the planned trajectory to Venus, where it should arrive in about 15 months.

The OMS-3 payload separation maneuver was performed following deployment of the Magellan spacecraft. The maneuver was 16.4 seconds in duration (31.0 ft/sec differential velocity) and placed the Orbiter in a 178 by 159 nmi. orbit.

The APU 2 gas generator/fuel pump system A heaters appeared to have failed off when first activated. About 2 hours later at 125:02:50 G.m.t., APU 2 gas generator/fuel pump heater system B heaters were activated to maintain the gas generator temperature above 190 °F. System B heaters operated satisfactorily for the remainder of the mission.

The text and graphics system (TAGS) paper jammed during the initial setup for the first transmission of 20 pages. The crew performed the inflight maintenance procedure on the TAGS and could not repair the malfunction as the jammed paper was not accessible. As a result, the TAGS was not operational for the remainder of the mission, but this did not substantially impact the mission as the teleprinter was used for uplinking data.

On flight day 2, the 10.2-psia cabin operations checkout was performed as DTO 0632. Cabin depressurization to 10.2 psia began at 126:19:49 G.m.t., and the cabin pressure was maintained at that level for about 24 hours. The launch entry suit helmets were evaluated during the prebreathing period and no anomalies were noted during the exercise. Cabin repressurization to 14.7 psia was completed at 127:19:47 G.m.t.

The flight control subsystem checkout was performed at 127:16:22:23 G.m.t. with all systems performing satisfactorily. APU 1 ran for 7 minutes 11 seconds during the checkout and consumed 22 lb of fuel. An RCS hot-fire test of all thrusters except failed R1U was also performed satisfactorily. An RCS trickle-current test was performed on the failed R1U thruster and no electrical problems were indicated.

At 127:19:46:14.141 G.m.t., general purpose computer (GPC) 4 experienced a fail-to quit. The dump data showed that GPC 4 had experienced a "machine check interrupt" parity error followed by GPC 1 and 2 voting GPC 4 out of the common set. Data analysis revealed a data parity external storage error, which indicated a possible hardware failure. The crew successfully performed an in-flight maintenance (IFM) procedure and replaced GPC 4 with the spare. After

performing the initial program load (IPL), the replaced GPC was configured into the common set and operated satisfactorily for the remainder of the mission.

The successful fluid experiment apparatus (FEA) middeck payload experiment provided micro-gravity research in the field of float-zone crystal growth and purification by melting test samples. The FEA activities involved completing three of four planned solid-material samples. The fourth sample melting was not performed because of higher priority activities involving replacement of the failed GPC.

All final entry preparations and stowage were completed, and the OMS deorbit maneuver was performed as planned with a differential velocity of approximately 326 ft/sec. At deorbit ignition minus 25 minutes, Space Shuttle main engine 3 regulator outlet B check valve exhibited reverse leakage when the helium system was configured for entry purge. This anomaly had no effect on the mission.

Entry interface occurred at the nominal time, and all subsystem performance and entry operations were normal. Main landing gear touchdown occurred at 128:19:43:25.90 G.m.t. (2:43:25.90 p.m. c.d.t.) on concrete runway 22 at Edwards Air Force Base, CA. Nose landing gear touchdown followed 12 seconds later with wheels stop at 128:19:44:29.96 G.m.t. The 10,295 ft rollout was nominal in all respects. All postflight subsystem reconfigurations were completed as planned with the APU's operating for 13 minutes 16.86 seconds after landing. However, prior to APU shutdown, data show that the EGT 2 sensor on APU 1 failed. The crew egressed the Orbiter at 128:20:40:49 G.m.t.

Twelve of the fourteen of the DTO's assigned to the mission were accomplished. DTO 0632, 10.2 psia Cabin Operations Checkout, was conducted using the launch entry suit helmets in a 10.2-psia cabin environment for 24 hours without anomalies. Seven of the eight assigned detailed supplementary objectives (DSO's) were accomplished. DSO 0462, Estimation of Central Venous Pressure During Spaceflight, experienced an equipment failure and was not performed.

SOLID ROCKET BOOSTERS

All solid rocket booster (SRB) systems performed as expected. The SRB prelaunch countdown was normal. SRM propulsion performance was well within the required specification limits. Propellant burn rates for both SRM's were near predicted values. SRM thrust differentials during the buildup, steady state, and tailoff phases were well within specifications. All SRB thrust vector control prelaunch conditions and flight performance requirements were met with ample margins. All electrical functions were performed as planned. Also, no LCC violations were noted.

The SRB flight structural temperature measurement response was as expected. Postflight inspection of the recovered hardware indicated that the SRB thermal protection system (TPS) performed as expected during ascent with very little TPS acreage ablation. Although the SRB nose caps are not usually recovered, the right SRB nose cape (beanie portion only) was recovered on this flight, and was in good condition with no missing TPS or debonded areas evident.

Separation subsystem performance was normal with all booster separation motors (BSM's) expended and the separation bolts severed. Nose cap ejection, frustum separation and nozzle jettison occurred normally on each SRB. All drogue and main parachutes were recovered.

The entry and deceleration sequence was performed as planned on both SRB's. SRM nozzle jettison occurred approximately 18 seconds after frustum separation. Parachute deployments were nominal, except for the left main parachute 2 which collapsed shortly after inflation. Postflight review of the parachute deployment films taken from the forward skirt dome cameras and Castglance aircraft confirmed the collapsed parachute. Because of the main parachute anomaly, the left SRB had a higher-than-normal water-impact velocity. This anomaly is believed to have contributed to other SRB/SRM anomalies. The first is that the left SRB External Tank attachment (ETA) ring cap and web separated for approximately 100 inches circumferentially on ring segment 283. The maximum gap is about 1/4 inch. A second anomaly relates to the left SRB nozzle snubber assembly ring which has displaced forward and wedged into the aft end ring. These anomalies are being evaluated at the time of this writing.

Postflight analysis of the Shuttle Range Safety System (RSS) indicates that the performance of the system for both SRB's and the ET was normal. The system signal strength remained above the specified minimum (-97 dBm) except for a 7-second duration at lift-off + 360 seconds when the signal level dropped to -104 dBm due to insufficient radio frequency (RF) energy supplied by the Range transmitter to the ET RSS antennas.

Other anomalies concerning the SRB's and SRM's that are under investigation are as follows:

a. Holddown post debris containment systems not seating properly.

b. SRB ETA ring cover bolts (4) sheared.

c. SRM factory joint weatherseals unbonding.

d. SRM igniter outer gasket secondary seal cut.

EXTERNAL TANK

During the safing procedures following the scrubbed launch attempt, the remaining liquid hydrogen recirculation pumps were shutdown, resulting in a stoppage of liquid hydrogen flow in the 4-inch recirculation line between the Orbiter and ET. Approximately 19 minutes and 14 seconds after the countdown was stopped, an unusual venting of gases was observed emanating from the region of the bellows in the ET portion of the 4-inch line. The gases, which initially were observed to have no specific velocity at the line, suddenly began to blow as if driven by pressure, indicating the possibility of a failure of a burst disk within the bellows. The line was replaced before the second launch attempt on May 4, 1989. Further investigation and testing indicated that no burst disk or bellows failure had occurred. Venting of the gases was caused by cryogenic

pumping around the bellows because of missing adhesive, resulting in air liquification/freezing, and the subsequent boiloff of vapor as the line warmed.

All objectives and requirements associated with ET support of the launch countdown and flight were accomplished. Propellant loading was completed as scheduled, and all prelaunch thermal requirements were met. TPS acreage performance was as expected for the existing ambient conditions, and there were no violations of the ice/frost criteria.

The Ice/Frost Red Team reported that there were small frost balls on the intertank, small thermal protection system (TPS) cracks on the longerons, and the expected ice on the disconnects. All items reported were within the ice/debris inspection acceptance criteria. There was no acreage ice on the ET.

ET flight performance was excellent. All electrical and instrumentation equipment on the ET performed properly throughout the countdown and flight. The crew reported an audible noise (clunk) at ET separation. Data have been reviewed and compared with previous flight data, and no evidence of any abnormal operation has been noted. The ET tumble system was deactivated for this launch. ET entry was normal and breakup and impact were within the predicted footprint.

SPACE SHUTTLE MAIN ENGINES

All prelaunch purge operations were executed successfully. Launch support ground support equipment provided adequate control capability for SSME launch preparation. All Space Shuttle main engine (SSME) parameters were normal throughout the prelaunch countdown, comparing well with prelaunch parameters observed on previous flights. All conditions for engine start were achieved at the proper times.

Preliminary flight data indicate that SSME performance at main engine start, mainstage, and during shutdown and propellant dumping operations was nominal with one exception. The engine 3 anti-flood valve downstream skin temperature sensor 1 failed off-scale high at lift-off + 413 seconds. High pressure oxidizer turbopump and high pressure fuel turbopump temperatures were near predicted values throughout the period of engine operation. The SSME controllers provided proper control of the engines throughout powered flight. There were no significant problems identified. Engine dynamic data generally compared well with previous flight and test data. All on-orbit activities associated with the SSME's were accomplished successfully.

ORBITER

The overall Orbiter performance was satisfactory with a total of 19 anomalies identified, of which one had a minor impact on the mission. The replacement of the failed computer resulted in one Fluid Experiment Apparatus test sample not being processed. All identified problems are discussed in the following

sections of the mission report, and the assigned problem number is shown the first time that a problem is discussed.

MAIN PROPULSION SYSTEM

The overall performance of the main propulsion system (MPS) was excellent. All pretanking purges were performed as planned. Liquid oxygen and liquid hydrogen loading was performed as planned with no stop-flows or reverts and the prepressurization and pressurization systems performed satisfactorily. Propellant loads were very close to the predicted inventory loads. During preflight operations, there were no hazardous gas concentrations of any significance detected, and maximum hydrogen levels in the Orbiter aft compartment were 170 ppm, which compares well with previous data from this vehicle. Also, there were no MPS LCC deviations or waivers during the countdown.

Trajectory reconstruction indicates that the vehicle specific impulse was near the MPS assessment tag values. Ullage pressures were maintained within the required limits throughout flight. Feed system performance was normal. Liquid oxygen and liquid hydrogen propellant conditions were within specified limits during all phases of operation, and all net positive suction pressure requirements were met. Propellant dumping and vacuum inerting were accomplished satisfactorily.

Prepressurization of the liquid oxygen tank was reduced by 2 psi (trip level reduced from 20.5 psig to 18.5 psig) to prevent flow control valves from closing during the engine start transient. The flow control valves remained open during the engine start transient and the early part of ascent and performed normally throughout the remainder of the flight. The actual ET ullage pressure slump after lift-off was within 0.1 psi of predictions and the minimum ullage pressure during the slump remained higher than on STS-29.

The following anomalies were noted during the mission:

a. The engine 3 gaseous hydrogen pressurant outlet temperature measurement (V41T1361A) failed off-scale high at approximately lift-off + 65 seconds (STS-30-02d).

b. The engine 1 liquid hydrogen inlet pressure measurement (V41P1100C) failed and began showing noisy data at approximately 450 seconds after lift-off (STS-30-02e).

c. During the entry manifold repressurization operation, engine 2 liquid hydrogen inlet pressure measurement (V41P1200C) was biased 10 to 12 psia with respect to the engine 3 and manifold pressure measurements (STS-30-02h). Since this transducer was not operating at cryogenic temperatures, this dispersion is not unexpected.

d. The initial launch attempt on April 28, 1989, was scrubbed because of a failure of the engine 1 liquid hydrogen recirculation pump (STS-30-03). The pump stopped during the terminal countdown when a

short developed within the pump electrical connector. The pump was replaced and operated satisfactorily for the launch on May 4, 1989.

e. The engine 3 750-psi regulator B outlet check valve had a reverse leak when A regulator was activated for the entry purge/repressurization operation at deorbit minus 25 minutes (STS-30-12).

f. Upon initiation of the MPS liquid oxygen manifold repressurization during entry, the gaseous oxygen disconnect pressure rise lagged the liquid oxygen manifold pressure by 1 minute 30 seconds (Flight Problem STS-30-22). The pressures should rise concurrently.

REACTION CONTROL SUBSYSTEM

The performance of the RCS was nominal with a total of 4139.1 lb of propellants being used during the mission. Two failures were noted, neither of which impacted the mission. Thruster R1U failed off on the initial firing attempt at 124:18:55:59.99 G.m.t., which was 13 seconds after ET separation (Flight Problem STS-30-05). A second failure occurred on flight day 2 when the right RCS oxidizer helium isolation valve A failed to close during a planned switchover from helium regulator A to helium regulator B (Flight Problem STS-30-09).

During the launch attempt on April 28, 1989, the butcher paper covering the L4U thruster was discolored, and attributed to a small oxidizer leak that was acceptable for flight. The butcher paper was replaced during scrub turnaround operations, and a sniff test revealed 10 ppm oxidizer vapor. Butcher paper was also changed on two other thrusters. The slight leaks of these thrusters did not affect the mission.

ORBITAL MANEUVERING SUBSYSTEM

Four OMS dual-engine maneuvers with a total firing time of 450.2 seconds were performed satisfactorily during STS-30 with nominal durations and differential velocities as shown in the following table. One anomaly was noted and it did not impact the mission.

Maneuver	Ignition time, G.m.t.	Firing duration, seconds	Differential velocity, ft/sec
OMS-1	124:18:57:28.48	141.79	226.8
OMS-2	124:19:31:26.28	125.40	197.4
OMS-3	125:01:16:21.09	16.59	31.0
Deorbit	128:18:40:49.13	166.08	326.2

Flight data indicate that the right-hand fuel quantity gauge decrease during the OMS-1 maneuver was less than the actual amount of fuel used (Flight Problem STS-30-08). The gauge indicated approximately 50 percent remaining during the OMS-2 and OMS-3 maneuvers. The gauge indicated a usage rate in excess of the actual rate during the deorbit maneuver, but read about 21 percent at the end of the maneuver.

The right-hand gaseous nitrogen regulated outlet pressure during the post-firing purges was below the specification value (Flight Problem STS-30-14). The lowest pressure recorded was 302 psia following the OMS-1 maneuver, however, the pressure was below the specification band of 325 psia +/- 10 psia for all maneuvers.

POWER REACTANT STORAGE AND DISTRIBUTION SUBSYSTEM

The power reactant storage and distribution (PRSD) subsystem operated nominally throughout the mission, providing 932 lb of oxygen and 117.5 lb of hydrogen for the fuel cells and 36.4 lb of oxygen for crew breathing. A 3.6-day mission extension at the average power level was possible with the reactants remaining at landing.

FUEL CELL POWERPLANT SUBSYSTEM

The fuel cell powerplant subsystem performed as predicted and satisfactorily provided 1366 kWh of electricity at an average power level of 14.1 kW while producing 1050 lb of water. No fuel cell problems were identified, but one fuel cell instrumentation failure occurred. The fuel cell 2 hydrogen flowmeter operated erratically in the mission; however, the meter began indicating nominal flow during the entry portion of the mission (Flight Problem STS-30-02f).

The fuel cells onboard the Orbiter were serial no. 120, 118, and 121 in positions 1, 2, and 3, respectively. The total fuel cell operating time for the first launch attempt and the mission was 138 hours. The fuel cells were shut down between the launch attempt on April 28 and the launch on May 4. The startup and operations of the fuel cells for both the launch attempt and the mission were nominal.

AUXILIARY POWER UNIT SUBSYSTEM

The APU subsystem operated satisfactorily throughout the mission and the 13 minutes and 16 seconds after landing. Total operating time for the APU's was 264.6 minutes not including the 18 minutes of operation during the scrubbed launch attempt. A total of 577 lb of fuel was consumed by the APU's during the mission plus 55 lb used during the launch attempt.

Four exhaust gas temperature (EGT) sensors failed, three of which failed during the scrubbed launch attempt and one which failed during the postlanding operational period. The three EGT sensors that failed during the launch attempt were APU 3 EGT 2, APU 1 EGT 1, and APU 2 EGT 1 (Flight Problem STS-30-02a, b, and c). EGT 2 on APU 1 failed after landing (Flight Problem STS-30-02g).

The APU 2 gas generator/fuel pump system A heaters failed to come on when activated at 125:00:15 G.m.t., after the initial on-orbit cool down (Flight Problem STS-30-06). This same problem occurred on this vehicle during the STS-27 mission. There was no mission impact as the system B heaters were turned on and operated properly for the remainder of the mission.

HYDRAULICS/WATER SPRAY BOILER SUBSYSTEM

The hydraulics/water spray boiler subsystem performed satisfactorily throughout the STS-30 mission, however, two minor problems were noted. During prelaunch operations, the water spray boiler 2 steam vent temperature was dropping and approaching the LCC minimum of 123 °F prior to the T-9 minute hold. The aft compartment purge gas temperature was increased by about 5 °F in an attempt to halt the dropping temperature.

The water spray boiler vent/nozzle temperatures were 10 °F warmer on the first launch attempt (April 28, 1989) than on the second attempt on May 4, 1989, (Flight Problem STS-30-21). These differences resulted from local weather conditions on the two days.

The water spray boiler 2 gaseous nitrogen regulator outlet pressure exhibited a minor leak (Flight Problem STS-30-10). The leak rate decreased throughout the 93-hour monitoring period to a rate of 0.09 psi/hr. This rate did not impact the mission. After new leakage requirements are established, the observed leakage rate will be acceptable.

During postflight inspections of the vehicle, fluid that is believed to be hydraulic in nature was found in both the left and right main gear wheel wells (Flight Problem STS-30-15). Samples were taken and analyzed. The origin of the leak is still under investigation.

PYROTECHNICS SUBSYSTEM

The pyrotechnics subsystem operated properly throughout the mission and all planned functions were completed. Two anomalous conditions were noted during postlanding inspection, one when a ET liquid oxygen umbilical yoke (pyrotechnic retainer clip) was noted to have fallen out of the umbilical cavity when the ET umbilical doors were opened (Flight Problem STS-30-18). The second anomalous condition was that two liquid oxygen umbilical detonators were noted to be missing. Similar occurrences have been noted on previous flights.

ENVIRONMENTAL CONTROL AND LIFE SUPPORT SUBSYSTEM

The performance of the environmental control and life support subsystem, which consists of the atmospheric revitalization subsystem, pressure control subsystem, active thermal control subsystem, supply and waste water subsystem, and the waste collection system, was satisfactory with one anomaly noted. During the scrubbed launch attempt, the cabin pressure transducer failed to react properly during the 16.7-psia checkout that is conducted after crew ingress (Flight Problem STS-30-01). After the launch scrub, a cap was found on the test port connected to the pressure transducer. The cap was removed and the transducer operated properly during the mission.

A one-point check during the launch scrub turnaround activities revealed a cabin pressure difference of approximately 0.2 psia between the actual and ground indicated pressures. This bias had no impact on the mission.

A 10.2-psia cabin operations checkout was performed satisfactorily for a 24-hour period in support of development test objective 0632. During the reduced cabin pressure test, a checkout of the new launch entry suit (LES) helmet retention assembly was conducted. All Orbiter subsytems operated properly during the period of reduced cabin pressure.

AIRLOCK SUPPORT SUBSYSTEM

The depressurization valve of the airlock support subsystem was used to depressurize the cabin during the 10.2-psia cabin operations checkout and the flow rate was normal. No other airlock equipment was operated as no extravehicular activity (EVA) was performed.

AVIONICS SUBSYSTEMS

The avionics subsystems operated satisfactorily throughout the mission. The Tracking and Data Relay Satellite (TDRS) was again used satisfactorily for data acquisition during the period of entry blackout. Several anomalies were noted and these are discussed in the following paragraphs.

General purpose computer (GPC) 4 experienced a "fail-to quit" (stop processing without orderly shutdown) at 127:19:46 G.m.t., and GPC's 1 and 2 voted GPC 4 out of the common set (Flight Problem STS-30-11). A decision was made to perform an in-flight maintenance (IFM) procedure and replace GPC 4 with the spare computer. The procedure required about 4 hours to perform and a majority of it was recorded using the camcorder flown as a demonstration for this mission. The spare computer operated as GPC 4 satisfactorily for the remainder of the mission.

The onboard hardcopier portion of the text and graphics system (TAGS) was jammed by paper while performing the initial procedure to configure the equipment to receive data (Flight Problem STS-30-07). The procedure requires 20 pages of paper be advanced, and the jam occurred on the nineteenth page. An IFM procedure was performed in an effort to remove the jammed paper, but without success. As a result, the TAGS was lost for the remainder of the mission.

Downlink television from payload bay camera A of the closed circuit television (CCTV) subsystem showed two translucent white spots and several black spots in the image area (Flight Problem STS-30-04e). The two overlapping white spots were about 1/8 inch in diameter and were located above the midscreen area. The five black spots were less than 1/32 inch in diameter and were scattered across the screen surface. All of these spots remained stationary when the camera was zoomed. This condition resulted in degradation of the video from that camera.

The tops of characters were not being printed by the teleprinter (Flight Problem STS-30-4f). The misprinting did not significantly affect the mission.

The communications cap headset for mission specialist 3 failed during entry (Flight Problem STS-30-13).

The crew reported that a lateral acceleration was noted following nose gear touchdown (Flight Problem STS-30-16). The nose wheel steering system was

enabled later than expected because of the combined effect of a very slow nose pitch-down rate and a slight nose wheel bounce (Flight Problem STS-30-16). The sequence allowed the two nose-gear proximity switches to disagree for approximately 0.32 second, and this disallowed the automatic engagement of nose wheel steering. The crew actuated the ET/SEP switch, which is a normal backup procedure, resulting in the nose wheel steering being enabled about 4 seconds after the weight on nose wheel (WONG) condition. To add to the dilemma when the nose wheel steering was enabled, the software abruptly drove the steering angle from the free caster angle to zero, causing a 0.10g lateral acceleration. A subsequent corrective turn back to the runway centerline resulted in a 0.25g lateral acceleration. Modifications will be made to the software to prevent these conditions from recurring.

In addition, a number of instrumentation sensors failed. Each of these is discussed within the subsystem that is supported by the particular sensor.

AERODYNAMICS

All aspects of aerodynamics performance were satisfactorily. The vehicle as well as the control surfaces responded as expected, and the angle of attack followed predictions. No problems were noted.

MECHANICAL SUBSYSTEMS

The mechanical subsystems performed as expected. During the landing rollout, light to moderate braking was used. Initial inspections of the brakes showed no damage. Main gear tire wear was higher than normal, but this was expected based on the crosswind loads experienced during landing.

The maximum brake pressure applied was 1008 psi, and the deceleration rate was maintained between 7.5 and 3.5 ft/sec/sec. Postflight inspections including x-ray revealed no brake damage. Likewise, the antiskid system performed normally and there were no indications of damage due to heating or instability. Postflight inspections also revealed red hydraulic fluid on the right-hand drag brace and the door drive linkage, as well as on the left-hand strut of the two main landing gear (Flight Problem STS-30-15). The source of this fluid is still being evaluated as this report is being published.

A higher-than-expected amount of tire wear occurred because of a combination of the crosswinds (12 knots) as well as runway maneuvering. The first and second of six tread ribs on the downwind side of each tire was worn more than the others. The two left-hand tires were worn more than those on the right, and this was possibly caused by the "heel-over" on the left-hand strut resulting from the crosswind from the right combined with the heavy right turn to return to the runway centerline. The second rib on the left-hand outboard tire and the right-hand inboard tire peeled tread rubber off in strips that impacted the Orbiter tiles, causing minor damage that will require tile repair or replacement.

THERMAL CONTROL SUBSYSTEM

The thermal control subsystem (TCS) maintained the Orbiter structural and component temperatures within allowable limits during all phases of the mission. With the exception of the APU 2 gas generator/fuel pump heater system A failure, all TCS heater systems performed nominally. This same heater failed on STS-27. Also, seven dithering thermostats were noted, none of which are considered a problem as this same performance was noted on a previous flights of orbiter vehicles.

THERMAL PROTECTION SUBSYSTEM AND AEROTHERMODYNAMICS

The thermal protection subsystem (TPS) performance was nominal, based on structural temperature responses and tile surface temperature measurements. The overall boundary layer transition from laminar to turbulent flow occurred at 1225 seconds after entry interface.

The runway inspection report indicated the TPS sustained minor damage. The nosecap, wing leading edge and the reinforced carbon carbon (RCC) chin panel all appeared to be in satisfactory condition. The elevon cove tile modification also appeared to be in satisfactory condition.

The flight had the least amount of ascent debris damage of any flight. Impact damage was minimal with a total of 151 hits, 52 of which had at least one major dimension of 1 inch or greater. Of the total number of hits, the Orbiter lower surface sustained 134 hits with 52 having a major dimension of greater than 1 inch. The majority of the lower surface damage was sustained during landing. This tile damage was aft of the main landing gears and was caused by shredded rubber tire tread. Approximately 60 impacts on the left side and 10 on the right side were identified as emanating from the tire treads. With this damage excluded from the total count, the lower surface had a total of 64 hits with seven larger than 1 inch. The base heat shield peppering was minimal. The right-hand inboard elevon sustained an impact that requires removal and replacement of one tile.

Nose landing gear door leading edge tiles showed several slumped edges and degraded repairs. Four tiles that were damaged enough to require removal and replacement were identified in this area. The nose landing gear door thermal barrier leading edge outer mold line (Nicalon) barrier was glazed as were the ceramic flow restrictors opposite the slumped tiles on the door. The ET door thermal barriers looked good, except for a minor tear on the forward latch patch. All main landing gear door tiles and thermal barriers were intact except for minor tears on the right main landing gear door 1 thermal barrier. One thermal barrier was protruding on the left hand side of the forward RCS module. The elevon-to-elevon gap showed eight breached gap fillers on both the right and left sides. The engine-mounted heat shield thermal curtains were damaged in the same manner as noted on previous missions.

One tile on the aft fuselage stub area was broken and will be replaced. The upper midfuselage, payload bay doors, OMS pods, vertical stabilizer, and body flap all appeared nominal with minor or no damage.

The Orbiter windows (1-6) were hazed with residual material noted on windows 3 and 4. Window 6 had a 0.080-inch diameter by 0.011 inch deep pit that is of unknown origin (Flight Problem STS-30-17). The window has been removed and sent to JSC for evaluation.

In support of DTO 0334, an aft bulkhead blanket inspection was conducted as part of the postflight activities. This postflight blanket inspection revealed three loose blankets and open snaps in six places (Flight Problem STS-30-20). Five open snaps were located along the upper edge of two blankets on the port side, and one of these two blankets had noticeable damage. Upon removable, this blanket was noted to be severely damaged with the aluminized Kapton back cover shredded and the blanket part number tag missing. Also, several layers of the internal multi-layer insulation were damaged. Five other blankets will also require rework or repair before reuse. A note of interest in that the four modified TCS blankets (installed vents and Beta cloth back covers) were undamaged.

CREW EQUIPMENT AND GOVERNMENT FURNISHED EQUIPMENT

All flight crew equipment performed satisfactorily except for the problems identified in the following paragraphs.

The Arriflex 16-mm motion picture camera operate lever failed to function (Flight Problem STS-30-04b). The crew performed an IFM procedure and camera operation was recovered. However, the camera then operated continuously unless the battery pack was removed, a procedure the crew used to conserve battery power and film.

The iris in the lens of one of the Hasselblad 70-mm cameras became jammed, and all attempts by the crew to unjam the camera were not productive (Flight Problem STS-30-04d). Also, the lens could not be removed. The camera was stowed for the remainder of the mission and a spare camera was used.

Following the initial launch attempt, the "C" retainer clip on the Mission Specialist 1 (MS1) right shoulder harness adjuster came out and the harness could no longer be tightened (Flight Problem STS-30-04a). Between the launch attempt and the launch, the MS1 seat and harness were removed and replaced.

The crew reported at 126:13:37 G.m.t., that the galley was dispensing indiscriminate amounts of water up to 12 ounces on the 8-ounce setting from the galley water dispenser regardless of the amount selected to be dispensed (Flight Problem STS-30-4c). The crew performed a malfunction procedure without any success, and it was also noted during the procedure that the chilled-water quick disconnect could not be disconnected. As a result, the crew connected a hose to the auxiliary-water personal-hygiene-system quick disconnect and were able to obtain ambient water in amounts of less than 8 ounces when required. Chilled water was only available in quantities of 8 ounces or more from the rehydration port of the galley. This workaround provided acceptable operations for the

remainder of the mission. Also, the crew reported that the culinary water supply contained iodine and bubbles which made the water unpalatable.

PAYLOADS

The primary payload, the Magellan spacecraft, was deployed satisfactorily at 125:01:01:32 G.m.t., and the solar arrays were successfully deployed 10 minutes later. Ignition for the solid rocket motor 1 firing occurred as planned at 125:02:01:32 G.m.t., and the firing achieved the desired trajectory. Ignition for the solid rocket motor 2 firing was on time at 125:02:06:42 G.m.t., and the Magellan spacecraft was on a satisfactory trajectory to Venus. Travel to Venus will require about 15 months.

The fluids experiment apparatus (FEA) contained four indium samples for processing during the mission. Processing of sample 5, the final sample, was not completed because of the IFM activities (higher priority) required to replace GPC 4, and low pressure in the sample. Sample 2 was not flown because of low pressure. The camcorder, flown as a demonstration on this mission, provided real-time data to document the processing of the samples and enabled ground personnel to evaluate the procedures and provide real-time modifications to the procedures to increase the chance of success.

The mesoscale lightning experiment (MLE) had several photographic opportunities, but very little photography was obtained during the passes. Photographic evaluation is still in progress as this report is being written.

Five daylight RCS tests were scheduled for the Air Force Maui Optical Site (AMOS) experiment. The tests on one orbit (49) were completely successful and the tests on orbit 34 were partially successful. The data acquired during these passes and from other flights are continuing to be processed by the U. S. Air Force customer.

DEVELOPMENT TEST OBJECTIVES AND DETAILED SUPPLEMENTARY OBJECTIVES

Preliminary data from the DTO's indicates that 12 of the 14 planned DTO's were accomplished. The DTO highlight of the mission was the accomplishment of DTO 0632, 10.2-psia Cabin Operations Checkout. The crew cabin was depressurized to 10.2 psia for 24 hours with no anomalies. DTO 0630, Camcorder Demonstration, provided excellent video of the flight including the FEA samples and the GPC IFM procedure. DTO 0785, Heads Up Display (HUD) Backup to Crewman Optical Alignment Sight (COAS), demonstrated that the HUD worked as well and as easily as the COAS. Although DTO 0517, Nose Wheel Steering, was not completed, enough data were obtained to indicate a need for a software change for the next flight. In DTO 0703, TDRS to TDRS Handover, transfer from the TDRS East to the TDRS West was accomplished. DTO 0728, Ku-Band Friction Test, required an additional run

due to a conflict with an operational change for the flight control system checkout. The data were invalid because of the cable unwrapping between the two attempts. DTO 0786, Text and Graphics System (TAGS) Test could not be conducted because of a paper jam that occurred when the equipment was being initially configured for receiving data.

Seven of the eight detailed supplementary objectives (DSO's) were accomplished. DSO 0462, Estimation of Central Venous Pressure During Spaceflight, was not performed because of an electronics failure in the Doppler blood flow detector.

DEVELOPMENT TEST OBJECTIVES

A listing of the 14 DTO's assigned to the STS-30 mission is as follows:

DTO No.*	DTO Title
308D	Vibration and Acoustic Evaluation
311D	POGO Stability Performance
0318	External Tank Entry Tracking
0333	Ascent Debris
0334	Aft Bulkhead Thermal Blanket Evaluation
0517	Hot Nosewheel Steering Runway Evaluation
0630	Camcorder Demonstration
0632	10.2-psia Cabin Operations Checkout
0703	TDRS-to-TDRS Handover Demonstration
0728	Ku-Band Antenna Friction
0785	Heads Up Display (HUD) Backup to Crew Optical Alignment Sight (COAS)
0786	Text and Graphics System (TAGS) Test
0789	Payload and General Support Computer (PGSC) Evaluation
0805	Crosswind Landing Evaluation

* D suffix identifies the DTO as a data-only test.

Preliminary results of the DTO's are provided in the following paragraphs.

0308D - Vibration and Acoustic Evaluation - The intent of this DTO was to obtain vibration and acoustic data during ascent. These data will allow definition of the operational vibration/acoustic environment for payloads and the payload deployment and retrieval system (PDRS). Data from various payload weights and volumes is desirable through STS-38. Data from eight acoustic microphones are recorded on the modular auxiliary data system (MADS) recorder as commanded by ground control for postflight analysis.

0311D - POGO Stability Performance - The purpose of this DTO was to obtain POGO (longitudinal oscillation) -related data from sensors mounted on each SSME. These data are recorded on the MADS recorder for postflight analysis.

0318 - External Tank Entry Tracking for the Eastern Test Range - The purpose of this DTO was to optically photograph the External Tank during entry to determine the rupture altitude of the liquid hydrogen tank and to determine if a differential velocity was imparted to the debris when the rupture occurred.

The Department of Defense Castglance aircraft was scheduled to obtain data on the ET breakup. However, because of DOD priorities, the aircraft could not support the Shuttle mission.

0333 - Ascent Debris - The purpose of this DTO was to assess the presence and source of debris during launch and ascent. A high-speed 16-mm motion picture camera was mounted on top of the pilot's panel, and the camera was actuated at lift-off by a lanyard attached to a toggle switch on the camera. The camera ran for about 160 seconds and provided data well past SRB separation. Review of the film revealed several pieces of butcher paper (used to protect RCS thrusters) during ascent and a minimal amount of SRB debris during separation.

0334 - Aft Bulkhead Thermal Blanket Evaluation - The purpose of this DTO was to conduct inspections and obtain photography of the thermal blankets on the aft bulkhead of the cargo bay. Unexplained off-nominal blanket conditions have been noted in previous postflight inspections.

Video data were obtained on flight day 3. Analysis shows all blankets in place. Some blanket bulging was noted, but there appeared to be no blanket damage. Several snaps appeared to be disengaged in the lower outboard corner of one blanket, however, this did not appear to be a flight problem. Video of the wing box area adjacent to the aft bulkhead (bay 13) did not show any debris or aluminized Kapton flakes.

0517 - Hot Nosewheel Steering Runway Evaluation - The purpose of this DTO was to obtain control data on the nosewheel steering system as well as eliminate the tire model uncertainty. This DTO was conducted in conjunction with DTO 0805. Data evaluation continues, but preliminary results indicated the need for software changes prior to the next flight.

0630 - Camcorder Demonstration - The purpose of this DTO was to evaluate a video camera and recorder in support of CCTV in the crew cabin. The demonstration was conducted throughout the mission with exceptional results. Operations included views of the in-flight maintenance procedure for replacement of GPC 4. Comments throughout the mission indicated that views from this camera both out the window and inside the crew cabin were excellent. Camcorders will be evaluated on four more flights.

0632 - 10.2-psia Cabin Operations Checkout - The purpose of this DTO was to checkout the new launch entry suit helmet retention assembly in a 10.2-psia environment prior to the planned use of the suit on STS-31. The cabin pressure was lowered to 10.2 psia for 24 hours and no anomalies were noted.

0703 - TDRS-to-TDRS Handover - The purpose of this DTO was to evaluate handover operations from TDRS West to TDRS East. Initial analysis indicates that this DTO was successfully completed on both the S-band and the Ku-band during revolutions 15/16 and 20/21. Other attempts were made, but antenna blockage and unsatisfactory line-of-sight conditions prevented obtaining more data. This DTO will be performed again on STS-34.

0728 - Ku-Band Friction Test - The purpose of this DTO was to obtain Ku-band antenna gimbal friction data after eight radar high-speed scans (special test of Ku-band antenna gimbals). Performance of this DTO was nominal, however, because of a procedural problem, the DTO was performed in two parts. A quick-look analysis of the data indicates that there was minimal antenna friction.

0785 - HUD Backup to COAS - The purpose of this DTO was to verify the suitability of the HUD as a star sighting device for inertial measurement unit alignments. Data takes were completed on flight days 1, 2 and 3. Some crew comments at the completion of the evaluation were that the reticle was better than the COAS, the upper right pattern was the best and the lower left was the second best, and marks are better than those obtained using the COAS. Both the right and left HUD compared very favorably.

0786 - Text and Graphics System Test - The purpose of this DTO was to obtain significant test and evaluation data on the TAGS in zero g and to compare with data from one g tests. During the initial set-up to receive data, a paper jam occurred and the DTO was not completed. For more information on the anomaly, see the Avionics Subsystems section of this report.

0789 - Payload and General Support Computer Evaluation - The purpose of this DTO was to verify that the payload and general support computer (PGSC) will functionally replace the Shuttle payload operations computer (SPOC) and provide a common crew interface for a variety of STS payloads. The PGSC was set up and evaluated on day 1 and day 2. On day 3, an evaluation was conducted with a 10-minute battery test and the floppy disk boot test. The crew reported that the screen was difficult to read under some sunlight conditions.

0805 - Crosswind Landing Performance - A crosswind landing was performed on Edwards Air Force Base concrete runway 22 with a crosswind component of approximately 12 knots with gusts to slightly higher levels. Postflight analysis is in progress.

TABLE I.- STS-30 SEQUENCE OF EVENTS

Event	Description	Actual time, G.m.t.
APU activation	APU-1 GG chamber pressure	124:18:42:16.02
	APU-2 GG chamber pressure	124:18:42:17.88
	APU-3 GG chamber pressure	124:18:42:19.60
SRB HPU activation	LH HPU system A start command	124:18:46:31.19
	RH HPU system A start command	124:18:46:31.51
Main propulsion System start	Engine 3 start command accepted	124:18:46:52.46
	Engine 2 start command accepted	124:18:46:52.58
	Engine 1 start command accepted	124:18:46:52.69
SRB ignition command (lift-off)	SRB ignition command to SRB	124:18:46:59.011
Throttle up to 104 percent thrust	Engine 3 command accepted	124:18:47:03.22
	Engine 2 command accepted	124:18:47:03.22
	Engine 1 command accepted	124:18:47:03.21
Throttle down to 65 percent thrust	Engine 3 command accepted	124:18:47:29.30
	Engine 2 command accepted	124:18:47:29.30
	Engine 1 command accepted	124:18:47:29.29
Maximum dynamic pressure (q)	Derived ascent dynamic pressure	124:18:48:05.09
Throttle up to 104 percent thrust	Engine 3 command accepted	124:18:47:54.90
	Engine 2 command accepted	124:18:47:54.90
	Engine 1 command accepted	124:18:47:54.89
Both SRM's chamber pressure at 50 psi	LH SRM chamber pressure mid-range select	124:18:48:58.61
	RH SRM chamber pressure mid-range select	124:18:48:58.97
End SRM action	LH SRM chamber pressure mid-range select	124:18:49:01.17
	RH SRM chamber pressure mid-range select	124:18:49:01.75
SRB separation command	SRB separation command flag	124:18:49:01.72
SRB physical separation	SRB physical separation	
	LH APU A turbine speed LOS*	124:18:49:04.13
	LH APU B turbine speed LOS*	124:18:49:04.09
	RH APU A turbine speed LOS*	124:18:49:04.17
	RH APU B turbine speed LOS*	124:18:49:04.21
Throttle down for 3g acceleration	Engine 3 command accepted	124:18:54:30.91
	Engine 2 command accepted	124:18:54:30.87
	Engine 1 command accepted	124:18:54:30.90
3g acceleration	Total load factor	124:18:54:31.01
MECO	MECO command flag	124:18:55:28.68
	MECO confirm flag	124:18:55:28.68
ET separation	ET separation command flag	124:18:55:45.67
OMS-1 ignition	Left engine bi-prop valve position	124:18:57:28.48
	Right engine bi-prop valve position	124:18:57:28.48
OMS-1 cutoff	Left engine bi-prop valve position	124:18:59:50.27
	Right engine bi-prop valve position	124:18:59:50.18

* = loss of signal

TABLE I.- CONCLUDED

Event	Description	Actual time, G.m.t.
APU deactivation	APU-1 GG chamber pressure	124:19:01:11.02
	APU-2 GG chamber pressure	124:18:01:14:07
	APU-3 GG chamber pressure	124:19:01:15.63
OMS-2 ignition	Left engine bi-prop valve position	124:19:31:26.28
	Right engine bi-prop valve position	124:19:31:26.28
OMS-2 cutoff	Left engine bi-prop valve position	124:19:33:31.88
	Right engine bi-prop valve position	124:19:33:31.68
Magellan deployment	Voice call	125:01:01:32
OMS-3 ignition	Left engine bi-prop valve position	125:01:16:21.09
	Right engine bi-prop valve position	125:01:16:21.09
OMS-3 cutoff	Left engine bi-prop valve position	125:01:16:37.68
	Right engine bi-prop valve position	125:01:16:37.48
Magellan first burn	Voice call	125:02:01:32
Flight control system checkout		
APU start	APU-2 GG chamber pressure	127:16:22:23.23
APU stop	APU-2 GG chamber pressure	127:16:29:34.21
APU activation for entry	APU-1 GG chamber pressure	127:19:00:05.07
	APU-2 GG chamber pressure	127:19:00:06.97
	APU-3 GG chamber pressure	127:18:31:52.66
Deorbit maneuver ignition	Left engine bi-prop valve position	128:18:40:49.13
	Right engine bi-prop valve position	128:18:40:49.21
Deorbit maneuver cutoff	Left engine bi-prop valve position	128:18:43:35.33
	Right engine bi-prop valve position	128:18:43:35.21
Entry interface (400k)	Current orbital altitude above reference ellipsoid	128:19:12:51.25
Blackout end	Data locked at high sample rate	No blackout because of TDRS
Terminal area energy management	Major mode change	128:19:37:10.51
Main landing gear contact	LH MLG weight on wheels	128:19:43:27.82
	RH MLG weight on wheels	128:19:43:25.90
Nose landing gear contact	NLG weight on wheels	128:19:43:37.89
Wheels stop	Velocity with respect to runway	128:19:44:29.96
APU deactivation	APU-1 GG chamber pressure	128:19:57:43.82
	APU-2 GG chamber pressure	128:19:57:45.18
	APU-3 GG chamber pressure	128:19:57:46.05

TABLE II.- PROBLEM TRACKING SUMMARY

Number	Title	Reference	Comments
STS-30-01	Cabin pressure transducer failed	PR-ECL-4-04-0337 CAR 30RF04 EECOM 01	Cabin pressure transducer failed to register cabin pressurization properly. Dust cap found on transducer port during recycle. KSC procedures revised. CLOSED
STS-30-02	Instrumentation:		
	a. APU 3 EGT 2 failed (V46T0340A)	CAR30RF05 MMACS 01	During APU startup, the EGT 2 on APU 3 failed. Remove and replace transducer. CLOSED
	b. APU 1 EGT 1 failed (V46T0142T)	PR-APU-A-0007 MMACS 01	During APU startup, the EGT 1 on APU 1 failed. Remove and replace transducer. CLOSED
	c. APU 2 EGT 1 failed (V46T0242A)	CAR30RF06 MMACS 01 PR-APU-4-04-0136	During APU startup, the EGT 1 on APU 2 failed. Remove and replace transducer. CLOSED
	d. SSME 3 GH2 pressure system temperature (V41T1361A) failed	PR-MPS-044-05-0497 BSTR 02 CAR30RF07	SSME 3 GH2 pressure system temperature sensor failed off-scale high during prelaunch operations. Remove and replace transducer. CLOSED
	e. SSME center engine LH2 inlet pressure transducer failed (V41P1100C)	CAR30RF08 PR-4-05-0498 BSTR 03	The SSME center engine LH2 inlet pressure transducer failed during ascent. Remove and replace transducer. CLOSED
	f. Fuel cell 2 hydrogen flow meter failed	CAR30RF09 PR-FCP-4-05-0107 EECOM 03	At 126:10:00 G.m.t., the fuel cell 2 hydrogen flow transducer (V45R0270A) shifted high by 0.2 to 0.3 lb/hr. The sensor started working properly at the end of the mission. Deferred to next flow. No mission impact.
	g. APU 1 EGT 2 failed (V46T0140A)	PR-APU-A-0007 CAR30RF11 MMACS 06	During entry, the EGT 2 on APU 1 failed. Remove and replace transducer. CLOSED
	h. Left SSME engine LH2 inlet pressure transducer biased low (V41P1200C)	CAR30RF12 BSTR 06	Data analysis verified that the bias (10 psi) present was nominal. No further action required. CLOSED
STS-30-03	SSME 1 LH2 recirculation pump failed	CAR30RF01 PR-MPS-4-04-0487 BSTR 01	SSME 1 LH2 recirculation pump failed. Intermittent short tripped ground phase B circuit breaker. Pump removed and replaced and retested OK. LCC being amended to change the power supply and GO if problem on ground side. If problem on flight side, NO-GO. CLOSED
STS-30-04	CFE/GFE		
	a. MS-1 right-hand shoulder belt adjuster "C" clip was missing	CAR30RF13 PR-LAF-4-04-0086	After first launch attempt, the MS-1 right-hand shoulder adjuster clip was missing. The MS-1 seat was removed and replaced before the launch on May 4, 1989. CLOSED
	b. Arriflex 16mm camera operate lever failed	FIAR BFCE-210F003 MMACS 04	The camera lever failed to function during crew photographic operations. Malfunction procedure implemented and camera function regained. No impact to mission. CLOSED
	c. Galley failures	FIAR BFCE-023-F003 FIAR BFCE-023-F004 EECOM 04	Galley water dispenser could not be selected; chilled water quick-disconnect failed; package-in-place lever stuck; and excessive gas bubbles in the water. Galley removed and returned to JSC for troubleshooting. No impact on the mission.
	d. Hasselblad 70mm camera failed	FIAR BFCE-210F002 MMACS 05	Camera shutter jammed. Camera removed and returned to JSC for troubleshooting and repair. No impact on the mission. CLOSED

TABLE II.- PROBLEM TRACKING SUMMARY

Number	Title	Reference	Comments
	e. CCTV camera A - spots on video image	DR BH930060 INCO 03	Translucent white and black spots appeared on video from the camera. Camera removed and returned to JSC for troubleshooting and repair. No impact on the mission. Silica intensifier tube replaced. CLOSED
	f. Teleprinter messages illegible	FIAR BFCE-029-F010 INCO 02	Top half of teleprinter characters did not print. Teleprinter removed and returned to JSC for troubleshooting and repair. No impact on the mission. CLOSED
	g. Gas bubbles in drinking water	Mission duration	During debriefing, the crew reported gas bubbles in the drinking water. Analysis inconclusive as to source of gas. Fly as is.
STS-30-05	RCS thruster R1U failed off after ET separation	CAR30RF14 PROP 01	RCS thruster R1U failed off after ET separation because of low chamber pressure. Pod removed and returned to HMF. No impact on the mission. CLOSED
STS-30-06	APU 2 GG fuel pump "A" heaters inoperative	PR-EPD-4-04-0551 CAR30RF15 MMACS 02	APU 2 gas generator fuel pump "A" heaters did not respond when heaters were switched on. Returned to "B" heater and system operation nominal. No impact on the mission. Failure not repeated with ground testing. Troubleshooting in progress.
STS-30-07	TAGS jam	PR-COM-4-05-0071 INCO 01	The onboard hardcopier jammed on nineteenth of twenty pages being advanced. In-flight maintenance procedure performed with no joy. TAGS removed postflight and returned to JSC for troubleshooting and repair. No impact on the mission. CLOSED
STS-30-08	Right OMS fuel total quantity gauge failed (V43Q5331C)	CAR30RF16 PROP 02	During OMS 2 maneuver, the total fuel quantity gauge stopped decreasing. Normal troubleshooting required in HMF. No impact on the mission.
STS-30-09	Right RCS A-leg oxidizer helium isolation valve (LV304) failed open	PR-RP01-11-0355 PROP 03	Right RCS A-leg oxidizer helium isolation valve failed to close. No impact on the mission. Troubleshooting required. Signal OK to pod connector. Metal chips found in connector around pins.
STS-30-10	Water spray boiler 2 nitrogen pressure decay (V58P0204A)	CAR30RF18 MMACS 03	Pressure decay noted downstream of gaseous nitrogen isolation valve. No impact on the mission. Normal checkout to OMRSD requirement. OMRSD to be changed.
STS-30-11	GPC 4 failed to synchronize	PR-DIG-4-05-0134 CAR30RF02 CAR30RF03 DPS 02	The system management GPC (4) experienced a failure to synchronize. GPC 1 and 2 voted GPC 4 out of the common set. GPC 4 was changed out using an in-flight maintenance procedure. GPC 4 returned to vendor for testing which to date has not duplicated the problem. Unexplained anomaly. CLOSED
STS-30-12	MPS SSME 3 regulator outlet "B" check valve leaked	PR-MPS-4-05-0503 CAR30RF19 BSTR 05	The MPS SSME 3 regulator outlet "B" check valve (CV45) had a reverse leak when helium system configured for entry. No impact on the mission. Troubleshooting could not duplicate problem. Valve to be removed and replaced. CLOSED
STS-30-13	MS-3 Communications cap headset failed	FIAR-JSC-EC-0393	The Mission Specialist-3 communications cap headset failed during entry. No impact on the mission. Cap returned to JSC for repair of broken wires. CLOSED
STS-30-14	Right OMS GN2 pressure regulator regulated low	---	Right OMS GN2 regulator regulated 5 psia below specification during OMS maneuver purges and postlanding tank venting. No impact on the mission. Standard OMI checkout required.
STS-30-15	Main landing gear fluid leak		
	a. Right-hand main gear	PR-MEQ-4-05-0234	Approximately 4 to 8 ounces of fluid were found in the right wheel well during the postlanding inspection. Troubleshooting in progress. No impact on the mission.
	b. Left-hand main gear	PR-MEQ-4-05-0235	Fluid found in wheel well during postlanding inspection. Trouble-shooting in progress. No impact on the mission. CLOSED

TABLE II.- PROBLEM TRACKING SUMMARY

Number	Title	Reference	Comments
STS-30-16	Nose wheel steering enabled late	CAR30RF23	Lateral acceleration after nose wheel touchdown of 0.25g confirmed. About 4-second delay from nose gear touchdown to nose wheel steering enable. Troubleshooting and analysis in work. No impact on the mission. Crew enabled nose wheel steering using ET SEP button.
STS-30-17	Ding on forward window no. 6	PR-STR-4-05-1575 CAR30RF24	Ding on forward window no. 6 was larger than allowable specification. Window removed and replaced and sent to JSC for analysis.
STS-30-18	ET LO2 umbilical yoke and detonators	PR-PYR-4-05-0075 PR-PYR-4-05-0073 CAR30RF25	Pyrotechnic retainer clip fell from umbilical cavity when ET door was opened. Two LO2 detonators were missing and were found on the runway. No impact on the mission. Redesign in work. Logic established to verify flight safety of present design. Fly as is CLOSED
STS-30-19	Commander's AVVI reading high during flight control system checkout	CAR30RF26	Commander's AVVI read 20,600 ft/sec during the flight control system checkout and should have read 20,000 ft/sec. No impact to the mission. Ground tests could not duplicate the error. Acceptable range to be added to Flight Data File.
STS-30-20	1307 bulkhead blanket damage	PR-TCS-4-05-0515 CAR30RF27	Two 1307 bulkhead blankets adjacent to those recently modified sustained cover damage. No impact to the mission. Blankets removed and replaced. Engineering instructions have been submitted for modified blankets.
STS-30-21	Aft fuselage temperature low during prelaunch operations	---	Water spray boiler vent/nozzle temperature was 10 °F warmer on first launch attempt. Difference was due to the different local weather conditions which were clear and sunny on the first attempt and cloudy and rainy on the second. No impact on the mission.
STS-30-22	During MPS LO2 manifold repressurization, GO2 pressure lagged manifold pressure	---	When the MPS LO2 manifold repressurization was initiated during entry, the GO2 disconnect pressure lagged the manifold pressure by 1 minute 30 seconds. The pressures should rise concurrently. The LO2 filter is suspected, but troubleshooting is required. No impact on the mission.
STS-30-23	High iodine concentration in drinking water		The crew measured the iodine concentration in the water on several occasions during the mission. The iodine level continued to increase throughout the flight and reached a level of 13 ppm late in the flight. Design of microbial check valve (injects iodine into water) is for 70 °F water, but water is at a much higher temperature. Further data will be collected durign future missions for use in a redesign of the valve.

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